

# A Catalogue of EQ-5D Utility Weights for Chronic Diseases among Noninstitutionalized Community Residents in Korea

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## ABSTRACT

**Objective:** The main purpose of this study is to provide a national catalog of preference-based utility weights associated with major chronic diseases in Korea.

**Methods:** The 2005 Korea National Health and Nutrition Examination Survey was used to get EQ-5D scores for 27 major chronic diseases. The independent detrimental effect of each chronic disease was estimated using a censored least absolute deviations regression.

**Results:** The respondents (60.5%) rated their health as perfect or 11111 on the EQ-5D scale showing ceiling effect. Stroke (0.5067–0.5756) was the condition of the lowest EQ-5D utility weight and was followed by

renal failure (0.6637–0.7739), angina pectoris (0.7325–0.8364), and arthritis (0.7621–0.8644). The marginal impact of each chronic disease after adjusting for age, sex, education, income, marital status, and the number of comorbid conditions was largest in stroke, arthritis, cancer, renal failure, and herniated disc.

**Conclusion:** This study provided a nationally representative catalog of utility weights for major chronic diseases in Korea. The three most burdensome chronic diseases among Korean adults based on the regression analysis were stroke, arthritis, and cancer.

**Keywords:** chronic diseases, EQ-5D, preference-based utility measure.

## Introduction

Quality-Adjusted Life Years (QALYs), which incorporates both survival and the impact of health-related quality of life in economic evaluations, become more important with increase of chronic diseases which are not fatal but affect quality of life. Health-related quality of life impact in QALYs calculation is measured by preference-based utility weights, which represent numerical judgments of the desirability of particular outcomes [1]. A weight of 1 corresponds to optimal health and a weight of 0 corresponds to the worst health state judged to be equivalent to death [1].

Utility weights of health states can be obtained from a number of preference-based measures such as the Quality of Well-Being [2], the Health Utility Index [3,4], the EQ-5D [5], and the SF-6D [6]. In 1993, the US Panel on Cost-Effectiveness in Health and Medicine (PCEHM) recommended the use of community-based, nationally representative utility weights to encourage comparisons across different health interventions [1]. In Korea, however, utility weights from foreign countries have been used for cost-utility analysis because there was no community-based, nationally representative utility weight set which can be useful in reimbursement decision.

The main purpose of this study was to provide a national catalog of preference-based utility weights associated with major chronic diseases in Korea. Disutilities due to major chronic diseases will also be provided.

## Methods

### Data

The 2005 Korea National Health and Nutrition Examination Survey (KNHANES 2005) were used to get EQ-5D responses and the information on chronic disease conditions, demographic

and socioeconomic characteristics. The KNHANES is a periodic nation-wide cross-sectional survey on various health-related questions including a nationally representative sample of noninstitutionalized community residents. More details about this survey such as representativeness of the sample, participation rates are provided in its progress report [7]. In the KNHANES 2005, all adults aged 19 and over were also asked to complete EQ-5D [7]. Completed EQ-5D responses from 23,520, among 25,487 adults aged 19 and over in KNHANES 2005, were used for utility weights measurement in this analysis.

Major chronic diseases in the KNHANES were defined by an expert panel based on the prevalence and the importance of diseases from the public health perspective. It should be noted that the diseases selected in this study do not exactly match the International Classification of Diseases system by the World Health Organization. Respondents who have had any chronic disease for longer than 3 months in the previous year or had it at the point of the survey are included to estimate utility weight of chronic disease. The major chronic diseases included in this study are listed at A Catalogue of EQ-5D Utility Weights For Chronic Diseases Among Non-Institutionalized Community Residents In Korea, *Value in Health*, Supporting Information, Table S1 at: [http://www.ispor.org/Publications/value/ViHsupplementary/ViH12s3\\_EKang.asp](http://www.ispor.org/Publications/value/ViHsupplementary/ViH12s3_EKang.asp).

### Measuring Utility Weights Using the EQ-5D

The EQ-5D, a generic preference-based measure, was developed by the EuroQol Group [8]. The EQ-5D consists of five questions regarding the current health status in terms of mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Each question has three levels indicating “no problem (or 1),” “some problems (or 2),” and “severe problems (or 3),” respectively. EQ-5D health states are defined as a combination of the levels of the five items. For example, 12111 represents a state where the level of mobility is 1, the level of self-care is 2, and the levels of usual activities, pain/discomfort, and anxiety/depression are all 1s. Because the EQ-5D has five items that each has three levels, it can describe 243 health states (3<sup>5</sup>).

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The EQ-5D has a few merits. First, it is easy to apply to a self-administered survey because it is relatively short and simple having only five items. Second, it is a generic measure in terms of disease, age, and setting [9].

Nevertheless, the EQ-5D has a serious ceiling effect problem. As many as 50% to 65% of the general population report the maximum value of the EQ-5D [10]. Belanger et al. compared the EQ-5D with the HUI3 in a community sample and reported that the EQ-5D classified 48% as being in full health whereas 26% on the HUI3 [11]. These findings imply that the EQ-5D may not be sensitive for the mild conditions.

Despite its weakness, the EQ-5D has been widely used worldwide because of its brevity and therefore for the purpose of international comparisons. There are 42 official EQ-5D language versions and much more countries have been using the EQ-5D. The Korean EQ-5D was also developed according to the recommended procedure by the EuroQol group and its reliability and validity were tested on rheumatic patients [12].

Measuring utility weights for health states in a generic quality of life measure like the EQ-5D needs the following four steps [13]: 1) systematic description of health states; 2) selection of some of all the possible health states; 3) measuring utilities for the selected health states from a general population; and 4) prediction of the utilities for all the health states using the measured utilities. Utility weights in the EQ-5D can range between 0 (death) and 1 (perfect health). The EQ-5D also allows negative utility weights for those health states worse than death.

There have been two studies on measuring utilities using the EQ-5D in Korea [14,15]. Both studies used time trade-off as a utility measuring technique. Nevertheless, the two studies were different in their samples, the health states directly asked to the respondents, and therefore the fitting regression models. The models can be provided by the authors on request. We used both models to estimate nationally representative utility weights of chronic diseases.

### Estimation of Utility Weights and Disutilities of Major Chronic Diseases

The mean EQ-5D index scores of individuals with the major chronic diseases in the KNHANES 2005 were estimated as the national catalog of preference-based utility weights for major chronic diseases. Diseases with fewer than 100 observations were excluded due to a concern of nonrepresentation. We also adjusted our results according to the specific guideline for the KNHANES sampling design and nonresponse [16]. To compare the EQ-5D utility weights of different disease groups, the age-standardized mean EQ-5D utility weights were estimated using the direct method.

Disutilities due to each chronic disease were also estimated using a multivariate regression analysis. Due to the ceiling effect evident in the EQ-5D index scores [17], ordinary least squares regression would result in biased and inconsistent estimates [18]. We also rejected to use Tobit model because assumption of homoscedasticity or normality of residuals was violated [19]. Therefore, we used censored least absolute deviations (CLAD) model.

All the analyses were performed with the STATA version 10.0 (StataCorp, College Station, TX).

## Results

### EQ-5D Distributions

Table 2 describes the frequencies of the most common EQ-5D health states, and can be found at A Catalogue of EQ-5D Utility

Weights For Chronic Diseases Among Non-Institutionalized Community Residents In Korea, *Value in Health*, Supporting Information, Table S2 at: [http://www.ispor.org/Publications/value/ViHsupplementary/ViH12s3\\_EKang.asp](http://www.ispor.org/Publications/value/ViHsupplementary/ViH12s3_EKang.asp).

The respondents (60.5%) rated their health as perfect. This implies that the distribution of the EQ-5D is highly skewed. It should also be noted that the top three health states comprised 80.9% of the whole sample.

Table 3 summarizes the EQ-5D index scores by socioeconomic characteristics and can be found at A Catalogue of EQ-5D Utility Weights For Chronic Diseases Among Non-Institutionalized Community Residents In Korea, *Value in Health*, Supporting Information, Table S3 at: [http://www.ispor.org/Publications/value/ViHsupplementary/ViH12s3\\_EKang.asp](http://www.ispor.org/Publications/value/ViHsupplementary/ViH12s3_EKang.asp).

This table also shows the mean number of comorbid conditions. The mean EQ-5D scores decreased as individuals become older. Women, those with lower education attainment, or those whose household income was lower had lower EQ-5D scores than their counterparts.

### Age-Standardized Utility Weights for Major Chronic Diseases

Table 4 shows the age-standardized mean EQ-5D index scores by 27 chronic diseases and can be found at A Catalogue of EQ-5D Utility Weights For Chronic Diseases Among Non-Institutionalized Community Residents In Korea, *Value in Health*, Supporting Information, Table S4 at: [http://www.ispor.org/Publications/value/ViHsupplementary/ViH12s3\\_EKang.asp](http://www.ispor.org/Publications/value/ViHsupplementary/ViH12s3_EKang.asp). The five most common chronic diseases in the 2005 KNHANES sample were dental caries, hypertension, arthritis, periodontal disease, and allergic rhinitis. Stroke was the condition of the lowest EQ-5D utility weight and was followed by renal failure, angina pectoris, and arthritis. The mean EQ-5D utility weights estimated by Nam's model [15] were higher than those estimated by Kang's model [14] for all diseases except stroke. Nevertheless, the rank orders of the EQ-5D scores based on these two models were very similar; the Spearman's rank correlation between the two estimates was 0.9841.

### Adjusted Impacts of Major Chronic Diseases on Utility Weights

Table 5 reports unadjusted mean and median EQ-5D utility weights as well as the 25th percentile and the 75th percentile and can be found at A Catalogue of EQ-5D Utility Weights For Chronic Diseases Among Non-Institutionalized Community Residents In Korea, *Value in Health*, Supporting Information, Table S5 at: [http://www.ispor.org/Publications/value/ViHsupplementary/ViH12s3\\_EKang.asp](http://www.ispor.org/Publications/value/ViHsupplementary/ViH12s3_EKang.asp)). The number of cases, mean age, and the number of comorbid conditions (NCC) are also presented. Table 5 also reports the 10 largest estimates of marginal impact of chronic diseases after adjusting for age, sex, education, income, marital status, and NCC.

When the extrapolation model developed by Kang [14] was applied, cancer, herniated disc, arthritis, osteoporosis, ulcer, stroke, asthma, glaucoma, cataract, and renal failure were found to significantly reduce the utility of health status for noninstitutionalized adults in the community. The extrapolation model developed by Nam [15] provided similar results, although the magnitudes of all the significant coefficients were smaller than those from Kang's model.

## Discussion

The study results, as obtained from nationally representative sample and community-based preference scores, can be used as

primary source of QALYs estimation for cost-effectiveness analysis because a catalog of preference-based provides a standardized and consistent source of utility weights [20]. Although this study was conducted in a Korean setting, it can provide a benchmark to other Asian countries and/or those countries at a similar gross domestic product level of Korea.

The ceiling effect in the EQ-5D was also evident in the 2005 KNHANES data as in other studies [21–23]. A percentage of our sample (60.5%) had the perfect score for EQ-5D index and three most common health states comprised 80.9%. This skewed nature of the EQ-5D implies the lack of discrimination for mild health states. Future studies may need to consider using alternative preference-based measures such as HUI3 or SF-6D which can describe much more health states than the EQ-5D.

It should be noted that the unadjusted mean and median utility weights for each chronic disease measured by the EQ-5D index scores cannot be considered as an indicator of the independent effect of each chronic disease because this difference may be related to the mean ages of these two populations as well as the disease characteristics. To draw the independent effect of each chronic disease on the utility weight, disutilities from each chronic disease was estimated by the CLAD regression analysis. The results showed that many chronic conditions had independent detrimental effects.

A few conditions did not have isolated detrimental effects on utility weights. This result is suspected to relate to the comorbid characteristics among the chronic conditions of interest. Further research is warranted to examine the comorbid status of each chronic condition and verify this hypothesis. We can also suspect that the relatively small sample sizes of several disease groups might have related to lower reliability of regression coefficients and nonsignificant effects.

Another notable observation from the results is that the two scoring algorithms produced very similar rank order of utility weights for major chronic diseases although there was a tendency that Kang's scoring system produced lower EQ-5D index scores and bigger disutility coefficients than Nam's one. This may be related to the interaction terms which provide additional effects of level 2 and level 3 in Kang's model. These additional terms may be related to the systematically lower scores. In sum, different scoring algorithms may not affect the priority setting, but may affect the absolute utility weights.

This study has some limitations. First, the major chronic diseases used in this study were defined based on an interview survey and therefore respondents' reporting error due to recall bias was likely to involve. Second, patients with relatively severe conditions were likely to be excluded because our sample consisted of noninstitutionalized adults. In this sense, our study results cannot be generalized to each of the studied conditions. Third, the scoring algorithm to produce the Korean utility weights uses time trade-off values. It is stressed here that it is standard gamble that can provide utilities that are more consistent with the inherent uncertainty in health decisions required by von Neumann Morgenstern expected utility theory [24]. Fourth, the regression analysis was conducted using a built-in program in Stata, which in this case sampling weights could not be incorporated. Nevertheless, this would not change the results, because a regression detects the independent effect of a variable on the outcome variable whether or not sampling weights were incorporated.

## Conclusion

This study provided a nationally representative catalog of utility weights for major chronic diseases in Korea in 2005, which was

recommended by the US PCEHM in 1993. This national catalog can be useful for comparisons across different health interventions in such settings as cost-utility or cost-effectiveness analyses. The five most burdensome chronic diseases among Korean adults based on the regression analysis were stroke, arthritis, cancer, renal failure, and herniated disc. Although the EQ-5D scores differentiated several chronic conditions as utility lowering conditions, more than half of the listed chronic diseases included in this study were not found to be significant utility lowering factors. More studies are needed to validate the utility weight of each condition obtained from our study by exploring alternative preference-based measures and utility producing methods.

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## References

- 1 Gold MR, Siegel JE, Russell LB, Weinstein MC. Cost-Effectiveness in Health and Medicine. Oxford: Oxford University Press, 1996.
- 2 Kaplan RM, Anderson JP. A general health policy model: update and application. *Health Serv Res* 1998;23:203–35.
- 3 Torrance GW, Feeny DH, Furlong WJ, et al. Multiattribute utility function for a comprehensive health status classification system: health utility index Mark 2. *Med Care* 1996;34:702–22.
- 4 Feeny DH, Furlong WJ, Torrance GW, et al. Multiattribute and single-attribute utility function the health utility index Mark 3 system. *Med Care* 2002;40:113–28.
- 5 Dolan P. Modeling valuations for EuroQol health states. *Med Care* 1997;35:1095–108.
- 6 Brazier J, Roberts J, Deverill M. The estimation of a preference-based measure of health from the SF-36. *J Health Econ* 2002;21:271–92.
- 7 Kang EJ, Nam JJ, Choi EJ, et al. The Progress Report on the 2005 Korea National Health and Nutrition Examination Survey. Seoul: Korea Institute for Health and Social Affairs & Ministry of Health and Welfare, 2005.
- 8 Euroqol Group. Euroqol-a new facility for the measurement of health-related quality-of-life. *Health Policy* 1990;16:199–208.
- 9 Rabin R, de Charro F. EQ-5D: a measure of health status from the EuroQol Group. *Ann Med* 2001;33:337–43.
- 10 McDowell I. *Measuring Health: A Guide to Rating Scales and Questionnaires* (3rd ed.). New York: Oxford University Press, 2006.
- 11 Belanger A, Berthelot J-M, Guimond E, et al. A head-to-head comparison of two generic health status measures in the household population: McMaster Health Utilities Index (Mark3) and the EQ-5D. *Statistics Canada Report*. Ottawa, Ontario: 1–62, 2000.
- 12 Kim MH, Cho YS, Uhm WS, et al. Cross-cultural adaptation and validation of the Korean version of the EQ-5D in patients with rheumatic diseases. *Qual Life Res* 2005;14:1401–6.
- 13 Brazier J, Ratcliffe J, Tsuchiya A, Salomon J. *Measuring and Valuing Health Benefits for Economic Evaluation*. New York: Oxford University Press, 2007.
- 14 Kang EJ, Shin HS, Park HJ, et al. *Valuing Health States Using EQ-5D*. Seoul: Korea Institute for Health and Social Affairs & Management Center for Health Promotion, 2006.
- 15 Nam HS, Kim KY, Kwon SS, et al. EQ-5D Korean Valuation Study Using Time Trade off Method. Seoul: Chung-nam National University & Center for Disease Control, 2007.
- 16 KCDC. *The Guidelines of Using the Raw Data of the Third (2005) National Health and Nutrition Examination Survey*. Seoul: The Ministry of Health and Welfare & KCDC, 2007.

- 17 Sullivan PW, Lawrence WF, Ghushchyan V. A national catalog of preference-based scores for chronic conditions in the United States. *Med Care* 2005;43:736–49.
- 18 Green WH. *Econometric Analysis* (4th ed.). Upper Saddle River, NJ: Prentice Hall, 2000.
- 19 Powell J. Least absolute deviations estimation for the censored regression model. *J Econom* 1984;25:303–25.
- 20 Sullivan PW, Ghushchyan V. Preference-based EQ-5D index scores for chronic conditions in the United States. *Med Decis Making* 2006;26:410–20.
- 21 Brazier J, Jones N, Kind P. Testing the validity of the Euroqol and comparing it with the SF-36 health survey questionnaire. *Qual Life Res* 1993;2:169–80.
- 22 Badia X, Schiaffino A, Alonso J, Herdman M. Using the EuroQol 5-D in the Catalan general population: feasibility and construct validity. *Qual Life Res* 1998;7:311–22.
- 23 Johnson JA, Coons SJ. Comparison of the EQ-5D and SF-12 in an adult US sample. *Qual Life Res* 1998;7:155–66.
- 24 Torrance GW. Measurement of health state utilities for economic appraisal. *J Health Econ* 1986;5:1–30.